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Long-term stability of deep current-driven supplies in Labrador Sea: Sm/Nd signature of sedimentary clay fraction for the last 360 kyr

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The production of deep water in the North Atlantic is one of the puzzle in understanding the oceanic influence in climate changes: it is believed that Pleistocene glacial to interglacial fluctuations in the exportation of North Atlantic Deep Water (NADW) to the Southern Ocean contributed to variations in atmospheric CO2 concentrations. North Atlantic paleoceanography has been mainly investigated for the Last Glacial cycle but a basic question remains: Is the last climate cycle representative for the whole Pleistocene?(e.g., Raymo et al., 2004). Most paleoceanographic reconstructions derived from biogenic proxies (benthic fauna species distribution, elemental chemical ratios, carbon or oxygen isotopic composition of benthic assemblages) that are sensitive to ocean ventilation and water mixings. Sedimentary abiotic components like magnetic properties (e.g., Kissel et al., 1997; Snowball and Moros, 2003), clay mineral assemblages (Bout-Roumazeilles, 1995; Fagel et al., 1997) or long period isotopic composition of clays (Bout-Roumazeilles et al., 1998; Frank et al., 2001; Fagel et al., 1999, 2004) were less investigated, even they bring indirect information on past circulation tracing the origin of the particles driven by the water masses. In this work, forty Sm-Nd isotope signatures were measured on the fine fraction of one sediment core (ODP Site 646) drilled in Labrador Sea, off Southern Greenland. Our aim is to record for the last four glacial/interglacial cycles (G-I) the relative contribution of fine particle supplies carried by the North Atlantic deep components into the Labrador Sea. Based on characterization of potential geographical sources of particles, three main sources contribute to the sediment mixture at core location: an old Precambrian crustal material from Canada, Greenland and/or Scandinavia (North American

Shield, “NAS”), a Palaeozoic or younger crustal material from East Greenland, NW Europa, and/or West Scandinavia (Young crust, “YC”) and, a volcanic source from the mid-Atlantic oceanic volcanism grouping Iceland, Faeroe Islands and/or the Reykjanes Ridge (“MAR”). On average for the last 360 kyr, the clay fractions from the glacial stages are characterized by the lowest Nd ratios (i.e., unradiogenic composition with more negative mean eNd = -15.7) than the fine material from the interglacial stages (mean eNd -11.5). The mean Sm/Nd signatures for glacial intervals OIS2, OIS6 and OIS10 lay along a mixing line that is parallel to the NAS-MAR axis: supplies characterized by young crustal Sm/Nd signature remain more or less constant (˜40%) between those three glacial intervals; whereas mean volcanic contribution increases, relatively to old craton material, from OIS 2 to OIS6 and, OIS6 to OIS10. The glacial OIS8 displays a mean Sm/Nd signature close to the interglacials OIS1, OIS5 and OIS9. As an exception, the mean OIS7 value plots along the YC-MAR axis. Its high YC contribution is peculiar but it contains ˜30% MAR like the other interglacial means. In addition to internal variation within an OIS (probably underestimated by sampling resolution), the average contribution in NAS drops by a factor of 2 between a glacial interval and the adjacant younger interglacial. This evolution is mainly counterbalanced by higher mean MAR contribution within interglacials. Such evolution remains relative: any NAS drop could be due either to a decrease of NAS supplies or to higher supplies from the two others end-members (dilution process). To decipher between higher supplies or dilution process, we estimate particle fluxes supplied by the end-members. NAS supplies are higher (relatively to the other end-members but also in absolute amount) during glacial intervals than during interglacials. On a long term scale, the fine particle suppplies in Labrador Sea are strongly controlled by proximal margin erosion: NAS supplies directly reflect the glacial stage intensity. In contrast, MAR fluxes carried by distal deep current from Eastern basins do not present significant G/I fluctuations for the last 360 kyr, except the marked increase in surface representative sample. Recent conditions appear quite peculiar: they may be related to the unusual recent open sea ice conditions in Nordic seas favoring ocean convection, responsible for the observed anomalous large volumetric flux of NSOW today (Raymo et al., 2004) and/or the full appearance of the Labrador Sea Water mass.

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